

Capping in a Wetland



**Impacts, Benefits, and Risks
Presented By**

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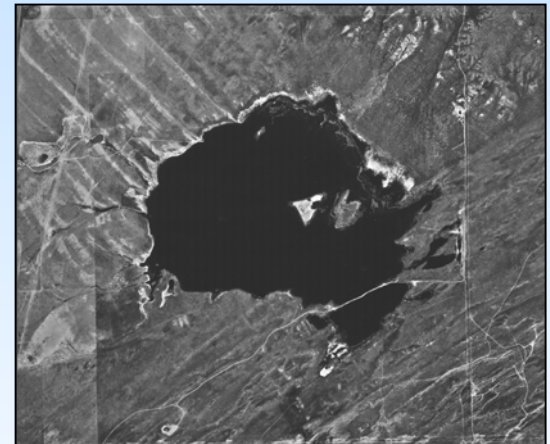
Site History

Soda Lake, Casper Wyoming

- Soda Lake, a playa lake, grew to 667 acres, plus the 45-acre Inlet Basin.
- Refinery discontinued pumping of process water in 1990.
- Pumped 1.7 mgd of fresh water from the North Platte River
- Fresh water input maintains the optimal water level to preserve the wildlife and habitat.



1954



1976

Current Site Conditions

- **350,000 cubic yards of refinery process residuals up to 9 ft thick.**
- **Impacted Sediment and porewater:**
 - Benzene up to 0.5 mg/kg
 - Total PAHs up to 800 mg/kg
 - Chromium up to 2,800 mg/kg
- **Water depth up to 12 feet.**
- **Extensive submerged and emergent aquatic vegetation.**
- **Site has been managed as a wildlife refuge since 1990.**



Cap Design Work

Physical Stability

- Process residuals are highly plastic with low shear strength
- 25-30% solids content
- No strength
- Highly compressive
- 90% fines

Natural Resources

- Wetland emergent vegetation total 37 acres. The Inlet Basin offers 11 acres of freshwater wetland habitat.
- There are three significant aquatic habitat types: brackish, freshwater, and “transitional”.
- Over 250 species of migratory birds and waterfowl, and a variety of mammals use Soda Lake as a foraging and breeding area. Threatened and endangered birds species have been sighted at the lake since 1982.
- This flyway site has been nominated as a Partners in Flight Important Bird Area.



Groundwater and Surface Water

- No refinery-related organic compounds were detected in groundwater or surface water. Metals (arsenic, barium, zinc) naturally elevated.
- Discharge lake. All water migrates into the lake. Only offsite pathway is evaporation (60 monitoring wells).
- Groundwater at Soda Lake is naturally non-potable due to naturally elevated salinity, total dissolved solids, and sulfates



Sediment

There may be some risk to ecological receptors due to exposure to inlet basin sediments because:



- Detected chemicals of interest exceeded ecological criteria: BTEX, PAHs, metals, dioxins/furans, and some pesticides.
- The system is slowly recovering through deposition of clean sediment, but it will take up to 100 years for natural recovery to occur.
- This clean sediment has allowed freshwater vegetation to become established, where none previously existed. It supports epiphytic invertebrates.

Birds and Fish



Fish

- No refinery-related organic compounds were detected in carp. Metals were detected in carp, but at levels similar to background.

Birds

- PAH metabolites were measured in bird bile at low to moderate levels when compared to other sites nationally.
- Nesting success rates for shorebirds and waterfowl were comparable to other sites. No observations of abnormal avian behavior or physical deformities in chicks.
- Diverse populations: The Inlet basin is used as forage by osprey, Caspian tern, cormorants, blackbirds, Black-crowned night heron, and dabbling ducks.

Potential Benefits of Capping

- \$5-\$20M cost savings over other alternatives.
- Controls direct exposure pathway.
- Site appears well-suited for management of contaminated sediments in-place.
- Community support for habitat preservation.



Potential Impacts of Capping

- Cannot be successfully placed over extremely soft sediments.
- Unknown technology to resource agency.
- Isolation fails through porewater migration of volatiles/methane.
- Short-term disturbance to invertebrate and bird community.
- Long-term loss of wetlands and habitat.



Final Design Specifications



- 6-acre cap, 950' by 260'
- Twenty-four 1.5-inch lifts
- 3 feet thick
- Spreader barge placement in deep areas
- Spray application in wetland areas
- Sand excavated onsite.

Spreader-dredge

- Modified MudCat dredge with drum winch and diffuser plate
- Cap Placement Avg: 128 Tons/Hr
 Max: 202 Tons/Hr



Post-Cap Placement Investigation 3 & 11 Months



- Bathymetry and settlement plates
- Cap coring
- Passive pore water collection
- Sediment traps
- Groundwater testing
- Wetland tissue and aerial coverage
- Invertebrate infauna recolonization
- Toxicity testing
- Bird surveys

Passive Pore Water Collectors

- 18-inch stainless steel/PVC samplers
- Osmotic bag used for collection
- Slowly equilibrates with surrounding pore water



Pore Water Analyte Concentration Comparison

Analyte	Units	Model	SLIB-02		SLIB-04	
		Results	Baseline	11 Month	Baseline	11 Month
Benzene	ug/L	46.4	24	0.2	18	1
Total Xylene (Calculated)	ug/L	198.3	139	< 0.6	75	< 0.6
Naphthalene	ug/L	34.2	110	< 0.5	54	< 0.5
Chromium	mg/L	0.0305	1.17	< 0.01	0.568	< 0.01
Lead	mg/L	0.0032	0.19	< 0.001	0.18	< 0.001
Cap Thickness	inches			21 inches		30 inches

Results and Conclusions

- Cap construction over very soft sediment is feasible.
- Monitoring results show favorable chemical, bathymetric, & physical stability.
- Chemistry data suggest that a thinner cap may provide adequate isolation.
- 11 months: wetland unaffected, but no recovery of submerged aquatic vegetation. Invertebrates recolonized but only the 1st instars.

Uncertainty: long-term recovery of habitat

Main Lake



Weight-of-evidence approach using 1) EPA PAH narcosis model, 2) toxicity tests, and 3) site conditions resulted in “No Further Action” status for the lake.

Client agreed to maintain habitat and continue pumping freshwater.....

Remediation Plans



Although the capping study showed adequate stability and protection of ecological receptors (no porewater flux), the client decided on dry excavation of Inlet Basin to eliminate long-term liability.

There were no mechanisms or champions for creative solutions. The birds lose.